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COMPARING SLEEP QUALITY OF NORMAL SUBJECTS AT HOME AND IN THE LAB

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INTRODUCTION

EEG measurements are considered the gold standard for the analysis of sleep. However, it is notoriously difficult to continuously measure EEG in long-lasting experiments, or outside a sleep research facility. If identification of sleep stages is not critical, actigraphy by wrist worn actometers can be used as an alternative way to describe sleep-wake behaviour. Indeed, actigraphy has proven to be a reasonable alternative for EEG-measurements bearing in mind some complications, especially in the analysis of sleep of people with sleep-disorders, such as insomnia[1].
Despite the fact that an extensive literature on the application and validation of actigraphy in sleep research exists[2], surprisingly few studies include a direct comparison between sleep actigraphy data collected in the home situation and data collected in the lab. In this study we compare sleep quality data obtained at home and in our sleep research facility in the same subjects, based on actigraphy, subjective sleep ratings, subjective sleepiness ratings and sleep diaries. In the lab situation, these measures are supplemented with EEG recordings.

METHODS

Data were derived from a previous experiment investigating effects of visual stimulation on sleep. A detailed description of the complete experiment has been presented before[3]. The study was carried out with 12 healthy young male (6) and female (6) subjects (18-27 years). Subjects did not smoke nor use drugs, and were asked to refrain from consuming alcohol and coffee throughout the experiment. Subjects did not score as extreme chronotypes. Subjects signed informed consent for participation in the experiment. The study was approved by the Medical Ethics Committee of the Academic hospital of the University of Groningen.
This study includes data of five consecutive days. Subjects spent the first three days outside the experimental facility, doing their normal daily routines. Subjects were asked to schedule their sleep approximately between 00:00-08:00 hours as much as possible. Also the fourth day subjects spent outside the experimental facility, until they were asked to come in at 20:00 hour. An electrode cap (Electrocap International Inc., USA) was applied and the subjects performed two baseline 35 minute computerized test series scheduled at 22:00 hour and 23:00 hour. Subsequently, subjects slept in the facility between ~00:00 hour (lights off) and ~08:00 hour (lights on), during which EEG was recorded. On the fifth day, subjects were woken up at 08:00 hour, had breakfast and subsequently performed two test series at 09:00 hour and 10:00 hour. After these sessions, the electrode cap was removed and subjects spent the rest of the day outside the experimental facility. At 20:00 hour subjects again entered the experimental facility and the sleep recording procedure was repeated.

On all five days, both at home and in the lab, subjects were asked to fill out a series of questionnaires around their sleep phase. At 23:00 hours, preceding bed-time, subjects filled out the Karolinska sleepiness scale (KSS)[4]. Following sleep, subjects filled out a standard sleep diary, the Groningen Sleep Quality scale (GSQ)[5], and again KSS. In the lab, the KSS questionnaire was included in the 23:00 hour and 09:00 test series. During the entire experiment subjects wore an Actiwatch-L® (Cambridge Neurotechnologies, Cambridge, UK) on the non dominant wrist. The Actiwatch simultaneously recorded the light intensity in Lux (0 - 50000 Lux) and wrist movements integrated over one minute epochs.
Activity data were analyzed using the vendor supplied program Actiwatch Sleep Analysis 2001. The medium sensitivity setting was used in the analysis to determine Total sleep time, Sleep efficiency and the Sleep fragmentation index. Immobile minutes and Sleep latency were also determined, as measures independent of the sensitivity setting of the analysis[6]. The timing of detected lights off and lights on were taken as Bed-time and Get up-time in the sleep analysis, respectively. All derived sleep parameters were calculated relative to these values.
EEG's recorded during the 2 nights spent in the lab were scored using standard scoring criteria. No REM-sleep onsets were observed, therefore non-REM stage 2 sleep always indicated sleep onset, and was used to calculate EEG based sleep latency relative to lights off.

RESULTS AND DISCUSSION

The different sleep quality parameters at home and in the lab are summarized in table 1. When subjects scheduled their sleep around 00:00-08:00 at home, on average they went to bed 24 min late, and got up 26 min late. Total sleep time consequently did not differ between home and the lab.
Considering the Actiwatch data, lab sleep onset was relatively early and sleep latency was 17 min shorter ($p<0.01$). Lab sleep efficiency was 5% higher ($p<0.01$). The amount of immobile time during lab sleep was 21 min longer ($p=0.02$), and also longer immobility bout sizes were found in lab sleep ($p<0.01$). Furthermore, sleep was less fragmented ($p<0.01$), and the Actiwatch fragmentation index was lower in lab sleep ($p<0.01$).
Based on actigraphy data, it can therefore be concluded that sleep quality was better in the lab, and certainly not worse than sleep at home. In support of this, subjects rated their sleepiness after waking up in the lab significantly lower (KSS after sleep: $p<0.01$), perhaps indicating more efficient sleep. The Groningen Sleep Quality scale, which surveys sleep complaints, did not significantly differ between the conditions, indicating that on average sleep at home and in the lab were regarded similarly good. EEG based sleep latency was 16 min longer than the actigraphy based estimate. Probably the actigraphy method is better suited to measure immobility associated with stage 1 NREM sleep, rather than the change to unconscious sleep (stage 2 NREM).
Thus, the data suggest that lab sleep in our cohort of young healthy subjects was as good in quality as sleep at home. It has to be noted though that three out of twelve subjects reported long sleep onsets and bad sleep (GSQ >10) during lab habituation nights. Therefore, habituation to sleeping in a novel environment remains important even when lab sleep in general appeared not to reduce sleep quality measures in our data.

Table 1. Overview of sleep quality parameters (mean and SEM), obtained during sleep at home and in the lab.Data were obtained by actigraphy (ACT), questionnaires (QUE), or via EEG measurements (EEG). P-values result from paired t-tests between home and lab data.

		Home		Lab		
		Mean	**SEM**	**Mean**	**SEM**	**p-value**
ACT	Bed-time / lights off (time)	0:18:52	0:12:26	23:57:55	0:01:58	*0.13*
	Get up-time / lights on (time)	8:29:57	0:15:14	8:03:42	0:01:43	*0.12*
	Sleep onset (time)	0:40:53	0:13:55	0:01:02	0:02:55	***0.02***
	Sleep latency (min)	22.00	5.05	4.80	1.17	***<0.01***
	Total sleep time (min)	467.33	9.83	479.58	2.56	*0.23*
	Sleep efficiency (%)	83.81	1.26	88.68	1.12	***<0.01***
	Sleep fragmentation index	30.95	1.28	26.12	1.75	***0.01***
	Time immobile (min)	401.06	8.54	422.38	2.94	***0.02***
	No. immobile phases	45.13	1.87	37.67	1.69	***<0.01***
	Mean length immobility (min)	9.27	0.38	11.74	0.55	***<0.01***
QUE	GSQ rating	4.72	0.43	4.83	0.58	*0.87*
	KSS bed-time	4.81	0.22	4.83	0.39	*0.94*
	KSS get up-time	5.86	0.51	4.71	0.41	***0.02***
EEG	Sleep onset (time)	-	-	0:18:33	0:01:59	-
	Sleep latency (min)	-	-	20.52	2.62	-

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